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Ecological Effects of Slash-disposal Fires on the Coeur D'Alene National Forest

ECOLOGICAL EFFECTS OF SLASH-DISPOSAL FIRES ON THE COEUR D'ALENE NATIONAL FOREST, IDAHO

BY

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INTRODUCTION

It is commonly known that modern forestry practices can be expected to influence wild animal populations (Leopold 1963, Brown 1961, Pengelly 1961, 1963). We are notably deficient, however, in detailed knowledge of the overall ecology of the forest environment and of the specific effects of land-use treatments on various units of any ecosystem.

To date, most wildlife forage has been created by accident: accidents of nature in the form of seed distribution, germination factors, wildfire, and climatic vagaries, and accidents of man in his use of fire, logging, and game-population control measures. Greater amounts of wildlife forage on the Coeur d'Alene National Forest are probably being lost through plant successional trends than through browsing pressure, and yet for the past 20 years the major management emphasis has been on increasing game harvests. It is now time to take positive action to increase game forage production based on the knowledge we have gained in recent years. We are now at the point where management must supplement its function of protecting existing forage resources by creating additional resources. From experience gained on the Coeur d'Alene study areas, reported in detail in the following pages, it is possible to suggest some means by which the above may be accomplished. This in no way minimizes the need to control animal numbers, and we may actually find it more necessary than before to protect the newly established stands of shrubs.

The Idaho Fish and Game Department and the U.S. Forest Service (Region I) initiated a cooperative short-term study on the Coeur d'Alene National Forest during the summer of 1964. The main objectives were to evaluate the effects of slash-disposal methods on logged-over units of the

Forest as related to game-forage production and to provide guidelines for the coordination of timber management and wildlife management. The author was the principal investigator, and both agencies provided part-time help. This study was the follow-up of a more detailed study conducted on the same Forest from 1949 to 1954 (Pengelly 1961, 1963).

Several areas previously studied (Beetle Creek, Jupiter Creek, and Horse Ridge) were rechecked, and two new areas (Jupiter Creek powerline, Mullan Tree Fire) were measured. All of these areas had been burned following logging; Horse Ridge in 1938 and the others from 1958-61. All the areas, with the exception of Horse Ridge, are in the Abies grandis/Pachistima myrsinites association within the Thuja plicata/Tsuga heterophylla zone, as described by Daubenmire (1952). Horse Ridge is in the Pseudotsuga menziesii/Physocarpus malvaceus association within the P. menziesii zone. For a more detailed vegetal description, the reader is referred to earlier studies on the Coeur d'Alene (Pengelly 1961, 1963) and to Daubenmire (1952) and Mueggler (1965).

Methods

In the original study (1949-1954) we followed the suggestion of Joseph Woolfolk, then Chief of the Division of Range Research, U.S.F.S., Region 1, and used the line-intercept method of cover analysis (Canfield 1941). I have described the two methods and the modifications made for use in heavy logging slash (Pengelly 1954, 1961, 1963). (See also Brown 1954, pp. 63-78; Heady et al. 1959, pp. 180-188; Parker and Glendening 1942; McCulloch 1955; Taber 1955).

The line-point method was eventually substituted for line-intercept because the former is a more convenient, faster, and equally accurate technique for surveying dense brushfields. One criticism of the intercept

technique has been that it is subjective, although this factor can be alleviated by having the same person repeat the measurements. (Brown 1954, p. 71) Since most techniques are difficult to repeat without measurement error, subjectivity alone is not ample reason for abandoning or discrediting the intercept method.

The number of transects sampled per area was based upon the size and apparent homogeneity of the vegetal cover and upon previous experience and statistical analysis (Pengelly 1961). Variations in sampling procedure are reported under each study-area discussion. Generally, we sampled the vegetation by using points (one-foot spacing) along a 100-foot transect, and considered any point (projected vertically) in contact with the crown or basal area a hit. Percent-coverage values were calculated for each species present on the transects. Only the species totaling more than one-percent coverage are recorded in the tables. Those listed as trace or less than one percent are lumped under miscellaneous in the good and poor forage categories.

Study Areas

Beetle Creek: From 1953 to 1957 an extensive logging program was launched in insect-infested timber in the Yellow Dog, Downey, Ash and Beetle Creek drainages tributary to the North Fork of the Coeur d'Alene River about eight miles above the Shoshone Work Center on the Wallace District. The area studied lies at about 3000-3500-foot elevation on moderate south and west slope approximately 400 yards above the valley floor. I reported the measurements taken in Yellow Dog, Downey, and Ash Creeks in 1957 and made suggestions for follow-up studies (Pengelly 1961).

In the August 1957 study at Ash Creek (west of Beetle Creek at a higher elevation) I first noticed that ceanothus seedlings were abundant in the ashes of a small five-acre accidental burn on south-facing slopes in the

logged area. The plants were difficult to identify in the newly sprouted condition and I recorded them as redstem ceanothus, perhaps in error. The entire area was burned in 1958 and is now heavily stocked with shinyleaf ceanothus. Both species of ceanothus are present in the Beetle Creek study area on north and east slopes, which further complicates an understanding of what really happened.

In 1958 the large clear-cuts were burned and subsequently sprayed for Ribes control. Plantations of Douglas-fir and white pine were established in 1961. Since no further treatments of the area are planned in the immediate future and the present silvical treatments may well be standard practice for similar sites, it seemed advisable to take a series of measurements in lower Beetle Creek on a site with winter-range potential for white-tailed deer and elk. Because former wintering areas for whitetails were eliminated by the construction of major log-hauling roads along the river, the creation of new ranges nearby in less exposed positions is desirable.

Ten 100-foot line-point intercepts were laid out in a systematic (non-random) manner in an east-west direction above the main Beetle Creek road (Fig. 1) in an area accessible to white-tailed deer. The outstanding feature of this area in 1964 was the almost complete dominance of the site by shinyleaf ceanothus (Table 1; Figs. 1 and 2), a species that was not present in the unlogged control plot in 1957. Shinyleaf now accounts for 50.2 percent of the ground cover and 57.5 percent of the botanical composition on 1000 feet of line. This species is not highly preferred by whitetails on this Forest but is listed under good forage because it is used by elk, muledeer, and, in limited amounts, by whitetails.

Other good forage species occurring in significant amounts by percent

Table 1. Comparison of ground coverage and botanical composition of common plants on Ash Creek and Beetle Creek logging areas, Shoshone County, Idaho. (All figures are percents.)

Plot location and history	ASH CREEK (1957)*						BEETLE CREEK (1964)*	
	Unlogged control		Logged 1956		Logged and burned, 1956		Logged 1956 Burned 1958	
	Ground cover	Botan. comp.	Ground cover	Botan. comp.	Ground cover	Botan. comp.	Ground cover	Botan. comp.
Good forage species								
Pachistima	34.0	59.6	30.0	44.8	Trace	Trace	6.0	6.8
Vaccinium	15.0	26.3	7.0	10.5	-	-	4.1	4.7
Amelanchier	Trace	Trace	1.0	1.3	Trace	Trace	Trace	Trace
Oregon grape	Trace	Trace	4.0	6.0	1.0	3.0	-	-
Redstem ceanothus**	-	-	-	-	23.0	69.7	-	-
Shinyleaf ceanothus	-	-	-	-	-	-	50.2	57.5
Miscellaneous[1]	-	-	-	-	-	-	4.1	4.7
Subtotal	49.0	85.9	42.0	62.6	24.0	72.7	64.4	73.7
Poor forage species								
Grand fir	Trace	Trace	7.0	10.5	-	-	-	-
Spirea	Trace	Trace	5.0	7.6	4.0	12.1	8.0	9.2
Snowberry	Trace	Trace	1.0	1.3	2.0	6.1	1.5	1.7
Rose	8.0	14.0	6.0	9.0	3.0	9.1	6.2	7.1
Rubus	Trace	Trace	5.0	7.6	-	-	4.6	5.3
Oceanspray	Trace	Trace	1.0	1.3	Trace	Trace	Trace	Trace
Miscellaneous[2]	-	-	-	-	-	-	2.5	2.9
Subtotal	8.0	14.0	25.0	37.3	9.0	27.3	22.8	26.2
TOTAL	57.0	99.9	67.0	99.9	33.0	100.0	87.2	99.9

* Denotes year of measurement.

** Recorded as redstem in newly sprouted condition - may have been shinyleaf ceanothus.

1 Miscellaneous good forage includes maple, willow, chokecherry, and elderberry.

2 Miscellaneous poor forage includes Douglas-fir, dogbane, and beargrass.

of ground cover were pachistima (6.0 percent) and vaccinium (4.1 percent). Unfortunately, these species are all low-growing forms that do not provide much forage under the deep snow that commonly occurs. Small amounts of taller, and therefore more available, species such as serviceberry, maple, willow, chokecherry, and elderberry were recorded on the transects. Subsequent remeasurements should be made to determine the abundance of these plants as the conifers regain dominance and as game utilize the existing shrubs.

A 1964 species listing of the five-acre Ash Creek accidental burn area of 1956 shows a pronounced change in composition in the intervening years from the 1957 survey (Table 1). In the first growing season after the 1956 burn, ceanothus plants showed the quickest response and were the dominant species in the sparse ground cover. A brief survey of the site in September 1964 revealed almost complete domination by shinyleaf ceanothus, with ninebark, pachistima, maple, vaccinium, mountain ash, beargrass, serviceberry, elderberry, chokecherry, and dogbane also present in addition to the spirea, rose, snowberry, and Oregon grape from the original listing.

Poor forage species are not expected to dominate the understory under any of the current logging treatments. On the Ash Creek portion of the study area these plants vary in total botanical composition from 14 percent in unlogged controls (Table 1) to 37.3 percent in recently logged sites. In the 1956 Ash Creek one-year burn and the 1964 Beetle Creek six-year burn they totaled 27.3 and 26.2 percent respectively. The species involved are generally low-growing shrubs that will not compete seriously with the good forage species.

On the north slopes opposite the Beetle Creek plots the influence of aspect, hence temperature and moisture, on shrub density and composition

is striking (Fig. 3). The slopes still reveal an abundance of blackened logs and stumps in the sparse shrub cover. On the other hand, an observer looking west up the drainage is struck by the lush green of the south slopes heavily stocked with shinyleaf ceanothus. The revegetation of the north slopes by shrubs and forbs might be proceeding more slowly with shade-tolerant species, or the difference might be attributed to the greater variation in intensity of the slash-disposal fires on moister sites.

No plots were measured on the north slopes, which were burned at the same time as the study area, but a listing of plant species was made. Shinyleaf ceanothus occurred in scattered locations on the exposed mineral soil of logging-spur berms and other relatively dry portions of this basically moist aspect, but nowhere did it achieve the blanketing effect noticed on south slopes. Scattered redstem ceanothus plants were found on the north slopes, but none on the south slopes of the study area. Pachistima, Rubus, willow, cottonwood, vaccinium, fireweed, spirea, elderberry, ocean-spray, serviceberry, grand fir, kinnikinick, twin flower, red osier dogwood, quaking aspen, chokecherry, snowberry, hemlock, rose, mountain ash, and miscellaneous herbaceous vegetation were also noted on the north slopes.

Summer use by game is evident on this area, but no information is available concerning winter use. Therefore, if an effective program of game and timber management is to be initiated, winter field checks of game use and spring pellet group surveys should be carried out regularly.

Subsequent periodic remeasurements of the Beetle Creek management unit should also be made to determine forage-plant trends, condition of the plant-ations, and the amount of natural conifer regeneration along borders of the logging area. The return to dominance by conifers has been hastened by the 1958 planting of Douglas-fir and white pine in the centers of the large

clear-cuts. The edges will probably seed in naturally from existing adjacent stands.

The Beetle Creek area was not managed specifically for wildlife-habitat improvement. The cut is too big to be uniformly used by game, and the portions of it that extend to high elevations near the head of Ash Creek and Flat Creek will be of little value to whitetails. Something can be learned here, however, to assist in future timber-wildlife management plans.

Jupiter Creek: In 1950 the Diamond Match Company logged approximately 40 acres of its land on the south slopes of Jupiter Creek, two miles west of the Shoshone Work Center. The area is similar in timber cover, slope, aspect, and elevation to the study areas in Beetle Creek. We selected it for study in 1957 because it was not burned following logging and was currently used by wintering elk and white-tailed deer. No game was known to winter there prior to 1954.

The 1950 cut was a heavy partial, with no provisions made for slash disposal. The 1957 measurements revealed a marked difference in shrub response on this unburned portion in contrast to the burned areas previously studied. A further change occurred when a powerline right-of-way was routed through the logged area. The 300-foot strip was cleared and burned in 1961. In 1964, vegetal composition was measured along the powerline (seven transects) as well as in the unburned 1950 logging site (three transects), which had also been measured in 1957. The disturbances created by the 1961 clearing for the powerline eliminated much of the original study area, so new markers were established.

Several obvious changes have occurred in the unburned portions since the 1957 measurements were taken (Table 2). There has been a recorded increase in pachistima, vaccinium, shinyleaf ceanothus, grand fir, and Rubus.

Table 2. Comparison of ground coverage and botanical composition of common plants on Jupiter Creek logging and powerline areas, Shoshone County, Idaho. (All figures are percents.)

Plot location and history	- 1957* - Unlogged control Ground cover	Botan. comp.	Logged 7 years Ground cover	Botan. comp.	- 1964* - Logged 14 years Ground cover	Botan. comp.	Powerline (cleared and burned, 1961) Ground cover	Botan. comp.
Good forage species								
Pachistima	4.0	8.7	1.0	1.4	2.3	3.6	3.6	5.8
Vaccinium	9.0	19.8	5.0	7.0	5.4	8.7	1.2	2.0
Amelanchier	2.0	4.2	6.0	8.3	Trace	Trace	Trace	Trace
Oregon grape	4.0	8.7	14.0	19.3	Trace	Trace	Trace	Trace
Redstem ceanothus	-	-	Trace	-	-	-	-	-
Shinyleaf ceanothus	0	0	?	?	6.3	10.1	38.8	62.8
Miscellaneous 1/	0	0	4.0	5.6	9.1	14.5	2.4	3.9
Subtotal	19.0	41.4	30.0	41.6	23.1	36.9	46.0	74.5
Poor forage species								
Grand fir	4.0	8.7	2.0	2.9	6.3	10.1	1.9	3.0
Spirea	1.0	2.1	10.0	13.9	0.9	1.4	-	-
Snowberry	4.0	8.7	14.0	19.3	12.3	19.6	3.3	5.4
Rose	10.0	21.6	6.0	8.3	4.0	6.4	0.2	0.3
Rubus					9.7	15.5	4.7	7.6
Oceanspray	1.0	2.1	1.0	1.4	-	-	-	-
Miscellaneous 2/	7.0	15.4	9.0	12.6	6.3	10.1	5.7	9.2
Subtotal	27.0	58.6	42.0	58.4	39.5	63.1	15.8	25.5
TOTAL	46.0		72		62.6		61.8	

* Denotes year of measurement

1/Miscellaneous good forage includes maple, red osier dogwood, mountain ash, and willow.

2/Miscellaneous poor forage includes Douglas-fir, hemlock, cottonwood, Ribes, and dogbane.

Serviceberry, Oregon grape, and oceanspray were not recorded in 1964, and significant decreases were noted for spirea, oceanspray, and rose. The differences could be accounted for by sampling, however, since the measurements were not taken along the same lines in 1957 and 1964. Snowberry measurements remained about the same.

In the adjacent powerline clearing, several outstanding differences in composition are apparent. Shinyleaf ceanothus is the dominant plant, comprising over one-third of all the ground cover and nearly two-thirds of the botanical composition. From Table 2 we can see that no shinyleaf ceanothus existed in the unlogged controls. None were found in the 1957 measurements of the seven-year-old logged and unburned area, although a few plants were outside the intercepts. Shinyleaf ceanothus, vaccinium, pachistima, and grand fir are increasing slowly on the logged (unburned) area (Fig. 7). By 1964 shinyleaf ceanothus comprised only 6.3 percent of the ground cover on the unburned area, while on the three-year-old powerline study area it amounted to 38.8 percent, or an increase of 616 percent.

Significant increases in total good forage were recorded--the good-to-poor browse ratio in the powerline strip is approximately 3:1, while in the logged and unburned area it is approximately 1:2. Good browse in the unburned area had declined slightly from 30 percent ground cover in the seven-year measurements to 23 percent in the 14-year measurements. This difference may not be significant and may be attributed in part to sampling error.

We encountered a few redstem ceanothus plants near the plots and along the exposed mineral soils of the skid roads, but none of the plots. Other species along the abandoned roads in varying sites were pussytoes, bracken fern, spirea, snowberry, Rubus, Ribes, cottonwood, willow, shinyleaf and

redstem ceanothus (Figs. 4 and 5), goldenrod, spotted knapweed, western white pine, larch, and Douglas-fir. The amount of game forage produced off-site along these roads has not been investigated. It could provide a clue as to germination requirements of some species in burned versus unburned disturbance sites.

Conifers such as hemlock can be expected to invade as conditions of shade and moisture become more favorable to them and will eventually dominate (Fig. 6) if fire is kept out of the area.

Burning the site created radically different conditions for seral shrubs, especially for shinyleaf ceanothus (Figs. 8 and 9). Since the powerline right-of-way will probably be treated periodically by the Washington Water Power Company to reduce vegetal growth and fire hazards, timber invasion on the site is not likely to occur. Arrangements should be made with the Diamond Match Company and the Power Company to leave this study area untreated until there is time for remeasurement and evaluation before treatment.

Tourist Creek: This area is known in the Forest Service as the Valiton's Sale Area. In 1963, 110 acres of mature timber were cut in two blocks (90 and 20 acres) on west-facing slopes of Tourist Creek below Little Guard Lookout and directly east of Beetle Creek. Other than in aspect, the area is similar to the Beetle Creek study area.

Cutting, hauling, and slash preparation were completed by the fall of 1964, and on September 9 and 10 the agency burned the two areas to dispose of slash and to prepare seed beds for conifer regeneration (Fig. 10).

We did not establish permanent study plots in the area, due to time limitations. The unburned debris from the logging operation made presampling impractical.

The mature timber stands adjacent to the cut were searched for redstem and shinyleaf ceanothus. None were found there, but in favorable locations along the main access road to the sale both species occurred in the exposed road cuts (especially between Bruce and Morris Creek). Since the only scarification during road construction was mechanical, it appears here, as well as at Jupiter Creek, that ceanothus seeds exposed to insolation alone will germinate, but that fire creates heavier stands. * Compared to mechanical scarification, fire provides more uniform and intense scarification over a larger area resulting in denser initial stands (Fig. 11). Heavy rains during August wet the slash and prevented a uniformly hot fire over the whole unit (Fig. 12).

On a dry, rocky ridge in the uncut forest adjacent to the southwest corner of the 90 acre clear-cut, the following species were noted: Douglas-fir, snowberry, serviceberry, ninebark, oceanspray, rose, Oregon grape, and spirea.

We made a partial listing of species on a wetter site a few hundred yards north along the west or lowest boundary of the cut. These included hemlock, pachistima, grand fir, maple, larch, twin flower, Rubus, and mountain ash.

At the east end or upper edge of the cut, the Forest Service had burned a small area in May, 1964, using helicopters for access, since deep snow drifts blocked the roads (Fig. 2). The plants in that area in September 1964 either escaped the fire, sprouted from unburned root crowns, or were produced from seed in the intervening period (approximately 100 days).

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* A visual inspection of the area in late August 1965 confirmed this. Many ceanothus plants of varying sizes (species undetermined) were found throughout the burn. Several of these new plants had crowns a foot tall and six-inch roots after only one summer's growth, due probably to the excellent moisture conditions in the 1965 growing season.

Ninebark (coppice regrowth) was the most common plant, although snowberry, rose, spirea, strawberry, and serviceberry were also abundant. Several mature maples were found in areas escaping the burn. Mature oceanspray plants are common, along with ninebark, south of the burn on the edge of the uncut timber.

A complete soil survey was not attempted, but we checked three sites: (a) Beetle Creek - burned in 1958 and currently covered with a heavy stand of shinyleaf ceanothus, (b) Tourist Creek - current logging but unburned, and (c) Tourist Creek - one-day-old slash fire site.

The Beetle Creek sample was a brown podzolic soil, loam texture, B horizon (iron-enriched) with a pH of 6.8 to 7.0.

The unburned sample from Tourist Creek was also a brown podzolic with gravelly loam texture, B horizon (iron-enriched), with pH of 6.3 to 6.5. It contained some forest litter and duff.

The sample from the Tourist Creek fire was mainly burnt forest litter and duff with a pH of 7.8 to 8.0.

These results are in line with what is known of soils in this area--slightly acid, brown podzolic soils, well developed under coniferous cover (i.e., the unburned sample at Tourist Creek). At Beetle Creek a similar site was burned in 1958, and by 1964 it had a nearly neutral pH under shrub cover. The burning at Tourist Creek created a temporary alkaline condition (pH 7.8 to 8.0).

The Tourist Creek area should be the object of continued observation. Permanent plots should be established within the next year. Records of game use of the area (by season and species) should also be made part of the wildlife records for the district.

Mullan Tree Fire: On August 22, 1961, a fire spread through 163 acres of logging slash and decked logs near the historic Mullan Tree marker north of U.S. Highway No. 10, 15 miles east of Coeur d'Alene. The terrain is moderately steep (Fig. 13) and slopes southward toward Fourth of July Creek near the highway. The elevation ranges from 3000-3500 feet, and the area lies in a fairly heavy snowfall belt (30 inches of precipitation annually). The forest cover is primarily a grand fir-pachistima association.

The fire, which began at the lower edge of the slope, burned hotly. A dense stand of herbaceous growth invaded the burn the following summer, and in the fall of 1962 the area was replanted to Douglas-fir. By 1964 the burned area supported a heavy cover of redstem ceanothus, a highly desirable game-forage plant. Resource managers could benefit from an understanding of this phenomenon. By altering the timing and intensity of slash fires, they can perhaps influence the density or composition of future vegetal cover.

Twenty 100-foot line-point transects were established in the burn; the results are tallied in Table 3. We found no shinyleaf ceanothus along the transects or in the rest of the burn and adjacent unlogged forest. The abundant redstem however, comprised 34.2 percent of the ground cover and 63.8 percent of the botanical composition. It occurred on every one of the transects, varying from six hits to 65 hits per 100 feet of line. Some mature redstem plants were found along the south margin of the fire (Fig. 14) These presumably were established after the mechanical scarification during road construction prior to the fire. The only other good forage shrub encountered on the transects was pachistima, which totaled less than one percent of the ground cover. Pachistima can be expected to increase as the site gets moister with the development of shade.

Table 3. Ground cover and botanical composition of common plants on the 1961 Mullan Tree fire area,* Kootenai County, Idaho.

	Number of hits	Percent Ground cover	Percent Botan. comp.
Good forage species			
Shinyleaf ceanothus	-	-	-
Redstem ceanothus	708	34.2	63.8
Pachistima	14	0.7	1.3
Vaccinium	-	-	-
Miscellaneous[1]	111	5.4	10.0
Subtotal	833	40.3	75.1
Poor forage species			
Snowberry	61	2.9	5.5
Spirea	17	0.8	1.5
Rubus	13	0.6	1.2
Grand fir	-	-	-
Rose	118	5.7	10.6
Miscellaneous[2]	67	3.2	6.0
Subtotal	276	13.2	24.8
	1,109	53.5	-
Forbs plus blanks	961		
TOTAL	2,070		

* Measured 6/64

1 Miscellaneous good forage includes Oregon grape, maple, willow, chokecherry, and elderberry.

2 Miscellaneous poor forage includes Douglas-fir, larch, Ribes, and ninebark.

Good forage species adjacent to the burn, in addition to pachistima and redstem, are maple, willow, vaccinium, serviceberry, and mountain ash.

Poor forage species are not very abundant at present, with rose (5.7 percent) and snowberry (2.9 percent) dominating. Traces of ninebark and Ribes were recorded on the transects, and mature stands of ninebark, oceanspray, and mock orange were present in adjacent timber stands. The ratio of good to poor forage is about 3:1.

During the first day of the 1963 hunting season, five elk were shot in the burn, and the area shows sign of much current use by deer and elk. This is a heavy snowfall area that has not been used previously by game in winter. Elk were reported to be wintering in portions of Mason Creek to the east of the burn in 1963-64. It is possible that during mild winters this burn, with its abundant feed source, will be increasingly utilized by game.

The Mullan Tree area should be examined from time to time in the next several years to determine seral shrub succession and animal use by season.

Horse Ridge: A heavy partial cut of mature Douglas-fir and ponderosa pine was made in 1938 on private holdings adjacent to Forest Service lands on Horse Ridge (Blue Lake) on the southwest corner of the Coeur d'Alene National Forest. The area was immediately blanketed with seral shrubs, which reached maximum development by 1953 (Pengelly 1961, 1963).

The terrain and climate are less severe here than in the Shoshone County study areas. Elevation is only 2600-3000 feet, and annual precipitation averages approximately 26 inches; deep snows are infrequent. The area studied lies in the Douglas-fir-ninebark association.

Because of its accessibility, its interesting vegetal history, and the previous studies already conducted there we selected Horse Ridge for remeasurement in 1964. Twelve 100-foot line-point transects were measured.

(The plot markers were destroyed by an unexpected logging operation during the winter of 1964-65 (Fig. 15). When the operation is concluded, the area should be re-examined. However, measurements are available for this area for 1953, 1957, 1959, and 1964.

In 1953 good forage equalled poor forage in total ground cover, but this relationship soon changed. Total shrub cover decreased from over 100 percent at that time to 87 percent (average for 1957 and 1959), with the greatest loss occurring in the amount of good forage. By 1964 the total shrub cover had declined slightly to 83 percent (Table 4) with further losses in good forage. From the 1953 high of 53 percent good forage, there was a significant decrease to 19 percent in 1959 and less than 13 percent in 1964.

The poor forage species currently dominating the site is oceanspray, which reaches heights of 10 to 15 feet. These huge fan-shaped shrubs compete successfully for light, moisture and space. Since they are rarely used as forage by game, they will continue to dominate the site until crowded out by conifers. We recorded 1255 hits on oceanspray out of a possible 2614 for a ground cover of 48 percent and botanical composition of 57.6 percent. Other poor forage shrubs included snowberry, ninebark, and rose (Table 4).

Redstem ceanothus, which once dominated the area (33.4 percent in 1953), dropped to 8.5 percent ground cover in 1959 and to 4.3 percent in 1964. Excessive competition by oceanspray and young conifers, in addition to utilization by game animals in winter, has created severe survival problems for redstem on this site. The intensity of the competition can be seen in the growth form adopted by several mature redstem plants. Individuals 10 to 12 feet tall with stems two to three inches in diameter are not uncommon (Fig. 16).

Table 4. Comparison of ground coverage and botanical composition of common plants following logging* on Horse Ridge, Kootenai County, Idaho.

	Number of hits	Percent Ground cover	Percent Botan. comp.
Good forage species			
Redstem ceanothus	112	4.3	5.1
Chokecherry	30	1.1	1.4
Willow	133	5.1	6.1
Maple	30	1.1	1.4
Miscellaneous[1]	33	1.3	1.5
Subtotal	338	12.9	15.5
Poor forage species			
Oceanspray	1,255	48.0	57.6
Snowberry	133	5.1	6.1
Ninebark	138	5.3	6.3
Rose	115	4.4	5.3
Douglas-fir	127	4.8	5.8
Miscellaneous[2]	73	2.8	3.4
Subtotal	1,841	70.4	84.5
	2,179		
Forbs plus blanks	435	-	-
TOTAL	2,614	83.3	100.0

* Logged 1938

1 Miscellaneous good forage includes serviceberry, Oregon grape, and pachistima.

2 Miscellaneous poor forage includes ponderosa pine, spirea, and mock orange.

Redstem will probably continue to decline, eventually existing only as seeds buried somewhere in the duff and mineral soil. There it will await the combination of circumstances that produced it after the 1938 logging and perhaps many times previously. The current logging in the area might be expected to renew the redstem, especially if the slash is disposed of by fire.

Meanwhile, current sales in Blue Lake Creek and Cottonwood Creek may create new forage sources for deer and elk. A better method of disposing of stumps, logs, and rock in road construction for these sales should be sought, however. Heavy windrows along the lower side of the roads are interfering with traditional game routes by blocking access to the roads and upper ridges. Openings should be burned or dozed through existing barriers, and future construction should not duplicate this situation.

SUMMARY AND RECOMMENDATIONS

Many apparent contradictions as to the effects of fire can be found from extensive fire literature review, from discussions with wildland managers, and from field observations and studies. We may conclude that fire is a rough and largely unpredictable tool due to the following variables: Time and intensity of burn, homogeneity of burn, kind and availability of fuel and seed source, and growing conditions during the first season after the fire. A forest is in part a chance combination of plants, and there is no way at present to guarantee results although we can predict, within limits, what kind and amount of vegetation will appear following disturbances. Through experimentation and experience we can achieve a measure of influence over the vegetal patterns of any given area.

The following observations seem to be generally true for the Coeur d'Alene Forest:

1. The decline in wild fires in Region 1 from an annual average of 250,000 acres at the turn of the century to less than 5,000 acres annually at present puts a serious limit on the future game range potential for the Region. Slash disposal by fire, following logging, which currently averages 100,000 acres annually, can be a useful and inexpensive treatment of mutual benefit to game managers and silviculturists alike.

2. The current practice of burning logging slash on the Coeur d'Alene National Forest does not appear to be creating harmful effects to soil, plant, and animal resources. Rapid revegetation heals the bare slopes, thus preventing erosion and leaching, and also produces useful wildlife forage.

3. All the post-fire shrubs are not palatable forage for game. Neither is all the palatable forage available or utilized, because of such

variables as animal habits, snow depths, plant height, and logging debris that block access to the area. Any attempt to create new game ranges should be based on knowledge of game behavior and current distribution.

4. The game ranges being created in north Idaho by slash burning have a limited life, probably not more than 30 years, and the current practice of establishing plantations, along with natural reseeding and shading out of intolerant shrubs, will considerably shorten the longevity of big game ranges. If timber managers maintain proper stocking rates the shrub stand can be expected to last considerably longer than 30 years.

5. The use of big game ranges created by slash fires will also be severely limited by (a) inaccessibility due to log jams caused by the felling and incomplete burning, and (b) poor site selection, such as north slopes at high elevations or extreme distance from game concentrations, and (c) cutting in blocks too large for acceptance by animals, especially whitetails, because of insufficient cover and snow accumulation. The log windrow barriers created by road construction should be prohibited.

6. Fire creates a favorable opportunity for redstem and shinyleaf ceanothus to germinate, although a limited number of seeds may germinate following mechanical scarification. In either case the seed must be present in the soil.

7. The low-growing ceanothus plants have limited use as winter forage in the deep-snow areas of the Coeur d'Alene. They also shade out rapidly, and the vast ceanothus stands created following fire are not as valuable a forage resource as one might think. This is especially true of shinyleaf ceanothus, which is not a preferred food of white-tailed deer in this area.

8. Follow-up studies should be conducted to determine game use of the areas, nature and rate of successional changes, influence of size and location of cut on snow depths, spring vs. fall burns, etc.

Any attempt to increase wildlife habitat through manipulation of existing vegetation by clearing and fire should be carefully coordinated with other land uses. Land managers should cooperate closely with State game authorities and together they should strive for public understanding and acceptance.

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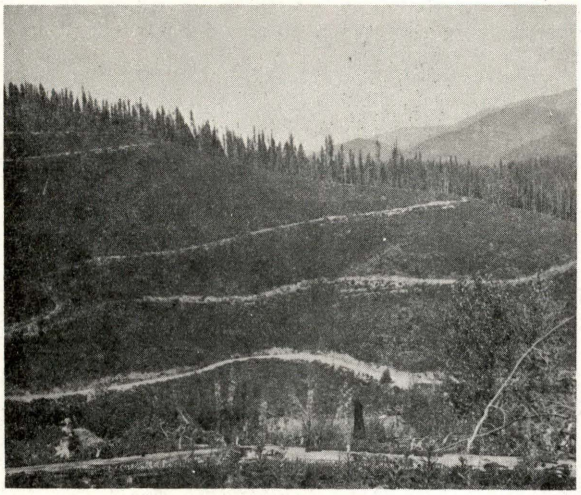

FIG. 1. NORTH ACROSS BEETLE CREEK. STUDY PLOTS ARE LOCATED BETWEEN SPUR ROADS IN CENTER OF PICTURE IN AN EAST-WEST DIRECTION. (9/64)

FIG. 2. EAST FROM BEETLE CREEK STUDY AREA, BURNED IN 1958 AFTER CLEAR-CUTTING IN 1955-57 AND LATER INVADED BY DENSE BRUSHFIELDS OF SHINYLEAF CEANOTHUS. (6/64)
(TOURIST CREEK CUT BELOW LITTLE GUARD MTN. - APEX BURNED 5/64 AND BALANCE 9/64.)

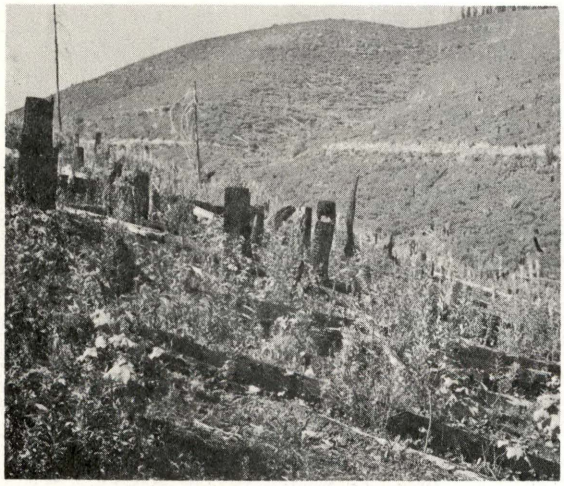

FIG. 3. WEST UP BEETLE CREEK. STUDY PLOTS ARE ABOVE ACCESS ROAD. THE COOLER NORTH SLOPES IN THE FOREGROUND HAVE A GREATER DIVERSITY OF SPECIES WITH LESS DENSITY THAN THE DRIER SOUTH SLOPES. (6/64)

FIG. 4. JUPITER CREEK ACCESS ROAD. VIGOROUS STAND OF SHINYLEAF CEANOTHUS (5' TALL) ON OUTER EDGE OF ROAD; BLACK COTTONWOOD IN BACKGROUND. (9/64)

FIG. 5. REDSTEM CEANOTHUS IN BARE MINERAL SOIL OF JUPITER CREEK ACCESS ROAD, ABANDONED SINCE 1961 POWERLINE CLEARING. (9/64)

FIG. 6. HEMLOCK AND GRAND FIR SEEDLINGS INVADING JUPITER CREEK ACCESS ROAD, CONSTRUCTED IN 1950 AND REBUILT IN 1961. (9/64)

FIG. 7. JUPITER CREEK. 1950 SALE AREA WEST OF POWERLINE. THIS AREA WAS NOT BURNED. (6/64)

FIG. 8. JUPITER CREEK POWERLINE CLEARING. SKID ROAD IN LOWER RIGHT CORNER MARKS BOUNDARY BETWEEN NEWLY CLEARED AND BURNED POWERLINE AND OLD (1950) LOGGING OPERATION. (6/64)

FIG. 9. JUPITER CREEK. VIEW SOUTHWEST FROM POWERLINE PLOTS ACROSS 1950 SALE AREA. (9/64)

FIG. 10. NINETY-ACRE TOURIST CREEK SLASH FIRE FROM YELLOW DOG BRIDGE, NORTH FORK OF COEUR D'ALENE RIVER. (9/9/64 - 5:30 P.M.)

FIG. 11. WEST END OF TOURIST CREEK FIRE. WET FUELS CAUSED SPOTTY BURN WHICH WILL INFLUENCE PATTERN OF SUCCEEDING VEGETATION. (9/10/64 - 3:30 P.M.)

FIG. 12. HEAVY FUELS NOT CONSUMED BY FIRE OF 9/9/64. PHOTO TAKEN BELOW MAIN TOURIST CREEK ACCESS ROAD JUST INSIDE SOUTH BOUNDARY. (9/10/64 - 11:30 A.M.)

FIG. 13. MULLAN TREE FIRE. VIEW NORTHEAST FROM FIRE ACCESS ROAD ON SOUTHWEST CORNER OF BURN. STUDY TRANSECTS RUN DOWN RIDGE FROM PLOT MARKER AT RIGHT EDGE OF SKID ROAD IN CENTER OF PICTURE. (6/64)

FIG. 14. MULLAN TREE FIRE. UNBURNED PORTION OF LOGGED AREA AT SOUTH EDGE OF BURN NEAR FIRE ORIGIN. THIS HEAVY STAND OF MATURE REDSTEM CEANOTHUS ALONG OLD LOGGING ROAD MAY HAVE BEEN ESTABLISHED FOLLOWING DISTURBANCE CAUSED BY ROAD CONSTRUCTION. (6/64)

FIG. 15. CURRENT LOGGING OPERATIONS ON HORSE RIDGE. AREA WAS LOGGED IN 1938 AND SUBSEQUENTLY INVADED BY A HEAVY STAND OF SERAL SHRUBS. (3/65)

FIG. 16. AN OLD (20-25 YEARS) REDSTEM CEANOTHUS PLANT ON 1938 LOGGING SITE AT HORSE RIDGE. FOLLOWING INITIAL ESTABLISHMENT, REDSTEM HAS DECLINED RAPIDLY SINCE 1953. (3/65)